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REQUIREMENTS DETERMINATION OF MAJOR WEAPON SYSTEMS

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THESIS

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of
Major Weapon Systems

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ABSTRACT

The major weapon system requirements determination process should lead to optimum solutions to meet perceived defense mission deficiencies. This thesis raises the question of whether the existing requirements process is adequate to support optimum solutions to meet defense mission needs.

Principal areas of concern which affect the soundness of the requirements determination function are addressed. These include:

a. Adequacy of information used for threat analysis.

b. The process of selecting specific requirements.

c. The timeliness and adequacy of information provided to the Secretary of Defense and Congress.

The thesis is intended as a conceptual problem statement regarding the function of requirements determination rather than as an across the board attempt to reconcile current individual programs to a single decision making standard.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

In order to meet the challenge of declining defense budgets and increasing weapon system costs we must choose wisely and manage well in the complex environment of major weapon systems acquisition. The general impression today is that the challenge is not being successfully met. The process used to acquire major weapon systems has been scrutinized for over a decade. Twice in the 1960's the Secretary of Defense made significant policy changes in an effort to change perceived weaknesses in the process. Policy changes have been made on a piecemeal basis however and there is growing concern that new policies are not directed at correcting deficiencies that are at the root of many acquisition problems. The findings of several recent study groups indicate that problems which appear during the system acquisition cycle can be traced directly to shortcoming in the requirements determination process.[1]

The requirements process is complex, unstructured, variable and not fully understood by participants or observers. It is characterized by widely diffused decision-making responsibilities and by low visibility of key requirements decisions. The process varies from Service to Service and

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[1]Study groups recommending improvements in the requirements determination process include: The Blue Ribbon Defense Panel, the Commission on Government Procurement, the Defense Science Board and the General Accounting Office.

weapon system to weapon system. It is influenced by changes in procurement policy, by changes in the economic and political environment and by the actions of participants in the process. It is this seemingly endless variety of the process that makes it difficult to analyze and control.

There is an immediate need to improve DoD management control and decision making in all phases of requirements determination. When this phase of systems acquisition is poorly managed the results are manifested in systems that are: too costly, too complex, unreliable, inefficient, incapable of meeting existing or forecast threats or designed to counter non-existant threats.

B. PURPOSE

The purpose of this paper is to examine the DoD requirements determination process and identify key phases of the process that are common to all weapon systems and Services. These key phases are then used to formulate a conceptual model of the process. The model is thoroughly analyzed and is used to identify deficiencies in requirements management control and decision making. Changes that will correct these deficiencies are then recommended. The recommendations include considerations of:

a. Who should be responsible for review of and control over the various phases of requirements determination.

b. What type of control should be exercised over each phase of requirements determination.

c. The type of information decision makers require in order to exercise effective control.

C. DEFINITION OF TERMS

1. Major Weapon System

For purposes of this paper a major weapon system is defined as a collection of interrelated parts that combine to perform a specific function to meet a specific need. Cost guidelines of over 50 million dollars for Research Development Test and Evaluation (RDT&E) or production costs estimated to be in excess of 200 million dollars will be used to identify current major systems. Equivalent cost guidelines will be used for weapon systems examples cited that were developed in the 1950's and 1960's.

2. Military Needs and Requirements

A need exists at the time it becomes known that a mission deficiency exists or may exist at some time in the future. The need may be caused by a change in an existing mission, a new threat, or simply the obsolescence of the means available to perform the mission. The requirement is the type of approach or system that is selected to fulfill a need. A defense requirement is the particular system approach selected using some means of analysis to choose from possible alternatives. A requirement can also be "generated" by the development of new technology. In this case there may be no mission deficiency but the new technology may suggest a system approach to perform an existing mission in a more effective manner. It is emphasized that a need

should not imply a particular system approach. A need is a perception which should be independent of the requirement ultimately selected to meet the need.

3. Requirements Determination Process

The requirements determination process should be the effort to find the most efficient means to satisfy the need. The most efficient means is that one which best reconciles the cost, time and capability goals in meeting a need.

D. REQUIREMENTS DETERMINATION MODEL

All major weapon systems pass through the following four phases or decision points during the requirements determination process:

Phase I: Formal statement of needed capability.

Phase II: Selection of requirement.

Phase III: Secretary of Defense approval.

Phase IV: Congressional approval.

1. Formal Statement of Needed Capability

The formal statement of needed capability is an interpretation of a mission deficiency by one or more of the Services. The need results from examination of national policy, perceived enemy threat and ability of current forces to counter the threat. Obsolete weapons may also create a "need" for a new capability.

2. Selection of Requirement

Research and development agencies in the Services then search for approaches to satisfy the statement of need.

Systems analysis[1] and early development prototyping may also be techniques in the selection process for determining the effective approach. The nature of the effort used to select an approach is dependent upon how the statement of need is presented. A statement that describes in detail the type of system, desired characteristics and performance specifications may limit alternatives or even predetermine a single approach. Needs stated in terms of the mission to be accomplished rather than as an outline of a predetermined solution gives much more flexibility to decision makers in Phase II of the process.

3. Secretary of Defense Approval

Once an approach to the problem has been adopted by the Service, development in that area continues until technical risk is thought to be reduced to an acceptable level and the program is presented to the Secretary of Defense for a confirming decision. It is possible that more than one program may be deemed necessary to provide a timely solution to a need either within a service or among services.

Secretary of Defense approval is necessary for the process to produce a systems approach that is presented to Congress for appropriation of funds. Without a Secretary of Defense approval, the process returns to the second

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[1]Systems analysis is the investigation and comparison of the effectiveness and costs of alternative means (systems) of accomplishing a stated objective. Here the objective is meeting a "need."

phase of the process. The decision at the Secretary of Defense level should be made with regard to activities conducted by the other Services to meet related need but frequently has not been predicated on this total view of a defense mission area.

4. Congressional Approval

The last step in the process is program approval by Congress. Although Congress normally doesn't determine requirements, no program will proceed without appropriations. Furthermore, Congressional review provides the opportunity for a Service to make a plea for a program which was disapproved in Phase III or for Congress to impose its own view of selected defense needs.

5. Conceptual Model

Figure 1 depicts the events and flow of information through a model of the requirements determination process. Each phase is discussed in detail in the following sections.

II. STATEMENT OF NEEDED CAPABILITY

A. INTRODUCTION

The first step in the proposed conceptual model of the major weapon system requirements determination process is a formal statement of needed capability. Statements of needed capability are documents produced by each of the services which state required capabilities for specific warfare areas such as "strategic offense" or "tactical air warfare." These documents are designed for use by research

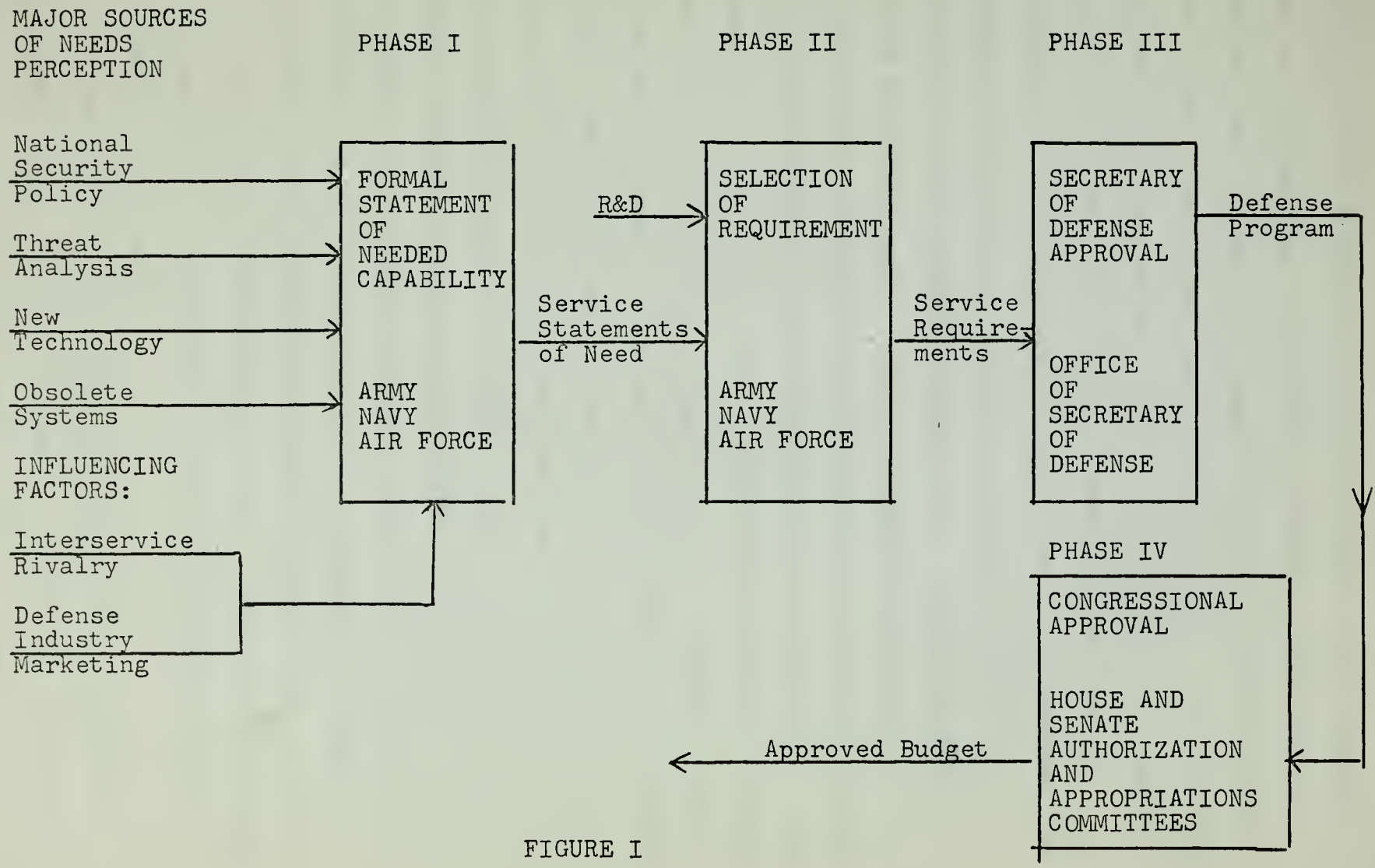
MAJOR SOURCES OF NEEDS PERCEPTION
PHASE I
PHASE II
PHASE III
National Security Policy
Threat Analysis
New Technology
Obsolete Systems
INFLUENCING FACTORS:
Interservice Rivalry
Defense Industry Marketing
FORMAL STATEMENT OF NEEDED CAPABILITY
ARMY
NAVY
AIR FORCE
R&D
Service Statements of Need
SELECTION OF REQUIREMENT
ARMY
NAVY
AIR FORCE
Service Requirements
SECRETARY OF DEFENSE APPROVAL
OFFICE OF SECRETARY OF DEFENSE
Defense Program
PHASE IV
CONGRESSIONAL APPROVAL
HOUSE AND SENATE AUTHORIZATION AND APPROPRIATIONS COMMITTEES
Approved Budget

FIGURE I

and development planners and should contain the following type of information: statements of mission deficiencies, desired levels of mission capabilities to be achieved, the time frame in which the capability is desired and the range of costs which can be expected to be allocated for resolution of the mission deficiency. There are two general categories of need statements originating from the Services, "product oriented" and "mission oriented." The first is a statement that specifies a particular system approach to meet a perceived need. Product oriented statements of need may define definite design concepts including detailed characteristics of a complete weapon system approach. These documents specify the solution when often their real purpose should be to state the problems in terms of mission deficiencies. A mission deficiency is the inability of a Service or Services to carry out stated National Security Policy objectives in a particular warfare area. Mission oriented statements of need should present the needs without necessarily including predetermined design approaches for meeting the needs. For example, if the mission was rapid worldwide deployment of men and material, the statement of needed capability should describe the time factor, number of men, size and amount of material and so on. The statement should not describe an aircraft with specific characteristics to accomplish the "need."

Presently the individual Services "are responsible for identifying needs and defining, developing and producing systems to satisfy those needs." [Ref. 9] Each of the

Services have plans that identify mission deficiencies and describe the long-range and mid-range forces and weapons they feel will be needed to carry out their roles and missions in the future. The planning methodology for the estimation of future military needs differs from Service to Service. In general however statements of needed capability are written by planning activities within the Services using the following sources of information: estimates of the future world situation; analysis of predicted threats; national security policies and objectives as they are discernible; the results of the several Services, Joint Chiefs of Staff (JCS) and DoD strategic and tactical studies; projections of current and programmed weapons capabilities, and technological forecasts. This information is assessed in order to discover significant mission deficiencies. The deficiencies are analyzed and evaluated and become the basis for each Services' statements of need.

The remainder of this section explores how statements of need should be written, various sources of perceived needs and problems that can arise during need evaluation. Emphasis is placed on analysis of the principal sources of need perception in an attempt to isolate those factors which influence Service perceptions of need. Examination of the requirements process indicated that there are elements in the sources of need perception used by the Services to formulate statements of need that may bias these statements and lead to later problems in the acquisition process.

Analysis of the information used by Services reveals that there are four Principal Sources of Need Perception. (see Figure 2) Each source is examined individually in the following sections.

B. PRINCIPAL SOURCES OF NEED PERCEPTIONS

1. National Security Policy

National Security Policy is the backdrop against which all major weapon system decisions are rationalized. The policy of "containment" and a corresponding strategy of deterence, now called "realistic deterence," has had a major influence on general purpose as well as strategic[1] weapon systems in the years since World War II.

The formulation of national policy is the responsibility of the President by virtue of power granted to the Chief Executive by the Constitution and by his role as Commander in Chief of the Armed Forces. The National Security Council is the forum for discussing policy issues. This organization provides the basis for presidential policy decisions. Approved policy documents such as the current defense Policy and Planning Guidance (PPG) are the source of policy guidance for the Services. Periodic examples of presidential policy changes occur at the beginning of a new administration, although these changes often have their roots in the previous administration.

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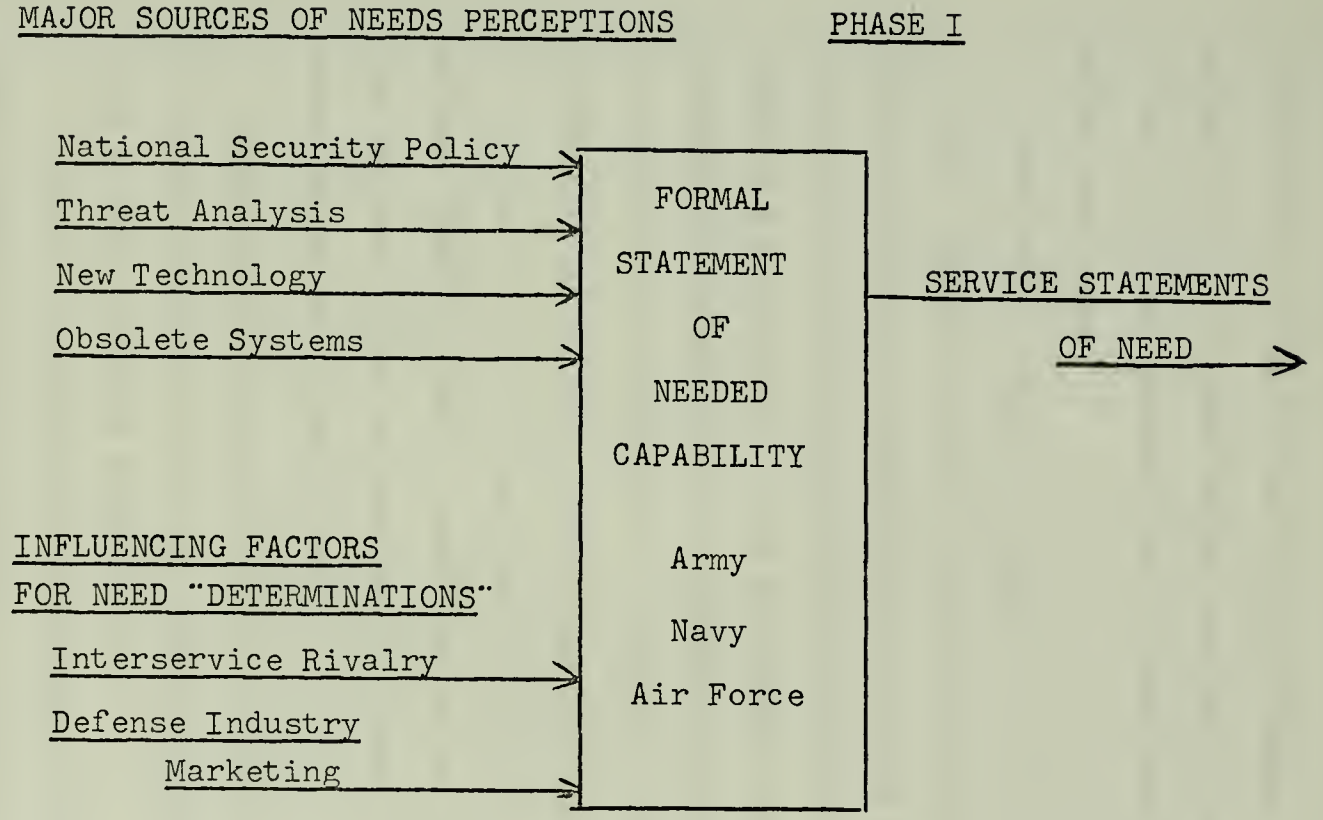
[1]General purpose forces are the forces which perform the entire range of combat operations short of general nuclear war while strategic forces are designed to carry out the long-range strategic mission in general nuclear war.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PHASE I
National Security Policy
Threat Analysis
New Technology
Obsolete Systems
FORMAL
STATEMENT
OF
NEEDED
CAPABILITY
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Navy
Air Force
SERVICE STATEMENTS
OF NEED
INFLUENCING FACTORS
FOR NEED "DETERMINATIONS"
Interservice Rivalry
Defense Industry
Marketing

FIGURE 2

How does National Security Council policy guidance directly affect the determination of requirements? An examination of some recent policy changes and the resulting emphasis given to particular missions gives an indication of how different perceptions of need result from national policy decisions.

Presidential policy changes in 1953 and 1969 resulted in severe defense budget reductions and greatly changed mission emphasis. During the Eisenhower administration only the Air Force whole-heartedly embraced the strategy of "massive retaliation." The Air Force engaged in extensive aircraft and ballistic missile development, while allowing its conventional capability to decline. Meanwhile conventional Army and Navy capabilities declined considerably. The driving force of Eisenhower's policy was reduction of defense spending rather than a major departure from Truman's strategy which also emphasized air power and nuclear weapons. Nevertheless the Eisenhower policy had a tremendous impact on requirements determination by reemphasizing nuclear strike retaliatory forces and relying primarily on the Air Force to achieve this capability.

In 1961 the strategy of "flexible response" together with increased military budgets, saw the restoration of "balanced" capabilities among the Services. Vulnerability-reducing measures for hardened and mobile strategic missile systems that had already been started were accelerated. Emphasis was placed on improving the capabilities of general purpose forces and on creating a rapid world wide deployment

capability for men and material. All of the Services started extensive new programs to meet the goals of the new policy. Implications of present policies for the requirements process are primarily a shift of emphasis away from an exclusive reliance on complex advanced technology and expensive multi-mission weapon systems toward a mix with greater numbers of austere, less expensive weapon systems.

A fundamental problem facing defense planners is interpreting national security policy. Documents from the President and the National Security Council which clearly state national security objectives have not always been presented to Defense planning agencies. Specific fiscal guidance was often not available to JCS and Service planning agencies. These planning considerations have resulted in each Service projecting its own estimate of national security goals. Currently the defense Policy and Planning Guidance (PPG) prepared by OSD does present presidential and National Security Council strategic and policy guidance to the Services. The Policy and Planning Guidance sets forth general defense policy and objectives for possible contingencies. Various levels of conflict are specified ranging from strategic nuclear war to deterrence of local conflict. The draft PPG is issued in the fall to give the services time to comment before the final PPG for the budget cycle is issued. [Ref.15]

Another problem related to policy is use of different planning horizons. The Services and JCS examine national security issues on a long term basis in order to anticipate

threats and to provide essential weapon development lead times. These planning horizons are being extended even further than the usual five to eight years in order to assess the long-term costs of proposed new weapon systems and their potential impact on the future size of the force structure. On the other hand, national security policy is often influenced by short-term political or economic goals, the pursuit of which can often contradict the long-term security objectives being pursued by defense planners. Plans and programs must then be altered, often at considerable expense, and accompanied by considerable criticism of defense planning efforts.

2. Threat Analysis

Another source of needs is the perception of new or augmented enemy threats. Identification of new threats is the task of the defense intelligence agencies. These agencies include the Defense Intelligence Agency (DIA), the National Security Agency (NSA) and the intelligence staffs of the Services. In addition to the importance of intelligence estimates in justifying new weapon systems, intelligence also plays an important role in national policy formulation. Former Secretary of Defense Laird, for example, undertook a wholesale review of Defense Department intelligence operations in an attempt to correct information deficiencies and improve intelligence effectiveness. One result of this review was the appointment of an Assistant Secretary of Defense for Intelligence.

Intelligence problems of concern to defense planning agencies included, poor coordination among various intelligence agencies, intelligence estimates that have a cautious "cover-all-bets" quality not very useful to planners and an over-emphasis on foreign capabilities as opposed to intentions. There is also a disposition among some intelligence agencies to weigh all intelligence in the light of an ultimate nuclear war against the Soviet Union. This produces an unbalanced outlook, making most intelligence seem either inconsequential or overpoweringly important. Finally, foreign perceptions of U.S. interests and possible courses of action in a given situation are frequently left out of intelligence evaluations.[1]

Recognition of deficiencies in intelligence estimates may be one of the main factors that led to the use of what former assistant Secretary of Defense for Systems Analysis, Alain Enthoven, referred to as a "greater than expected threat" estimate. Enthoven explained how the "greater than expected threat" is arrived at. "We begin with the National Intelligence Estimate (the intelligence community's agreed prediction of likely military developments). We then use a planning and analytic device called the "greater than expected threat." What we do is to develop a substantially larger threat than the National

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[1]These and other intelligence problems encountered by the Nixon NSC are recounted by Washington journalist John P. Leacacos in an article published in Foreign Policy, Number 5, Winter 1971-1972.

Intelligence Estimate shows. This is developed by consulting various of the experts around the Government." [Ref. 19]

Rationale for using "greater than expected threat" estimates is that if the Soviets should respond to our new developments, this response has already been accounted for by the standard against which we are currently building. Consequently there would be no need to respond with additional weapons improvement. In practice, however, once the Soviets deploy a force which approaches the current "greater than expected threat," then by definition, a new "greater than expected threat" is generated and additional weapon system development is undertaken to meet it.

A current weapon system example may give some insight into the role of intelligence and threat analysis in defense planning. The Poseidon missile system was originally designed to penetrate the Soviet TALLINN system, a system originally thought to be a widespread ABM defense. When intelligence agencies determined that TALLINN was an anti-aircraft system, the deployment decision on Poseidon was not reversed. The Poseidon deployment decision was made against a threat which never materialized. Despite the disappearance of the threat against which it was designed, the Poseidon was continued as a hedge against other potential threats, including faster-than-expected Soviet deployment of the SS-9 ICBM.[1]

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[1]The sequence of Poseidon system development is based on testimony given by Dr. John S. Foster, former Director of Defense Research and Engineering in 1968 before the Senate Armed Service Committee.

The major difficulty with knowingly inflated intelligence estimates of enemy capabilities and use of "greater than expected threat" estimates is that we tend to "require" more capability in weapon systems than we need or can afford.

The problem of what contingencies and risks to guard against is the heart of threat priority analysis. There are an almost unlimited number of threats which can be projected. The likelihood of their occurrence however varies from "significant possibility" to "remote contingency." An attempt to counter all projected threats would inflate defense requirements beyond our ability to satisfy them. In addition, once priorities are established, the degree of complexity and performance capability built into a system depends to a large extent on an evaluation of the threat which the weapon is expected to counter.

Statements of need should be written against a background of realistic threat analysis. Measures to ensure that the threat is not exaggerated are difficult to describe. Reviews of stated needs which emphasize both budget constraints and realistic projection of enemy capability may discourage the tendency to request more mission capability than is fiscally prudent. These reviews should occur at both Service and OSD levels.

3. New Technology

New or improved technology is another source of needs and is often closely related to threat analysis. New technology may allow for improvement in an existing weapon system. The justification for the improvement may

be a hedge against a possible new enemy threat. As technology advances we project it forward into the Soviet arsenal, thereby creating new potential contingencies to be covered by our own forces. New technology also presents the possibility of designing weapon systems to guard against contingencies which it had not been previously possible to protect against.

Continually advancing technology and the apparent risk aversion of defense planners (exemplified by use of "greater than expected threat" estimates) have combined to produce complex, expensive weapon systems in an attempt to cover all possible contingencies.

Defense Space Market Research, a publication prepared by businessmen from weapons firms and research organizations described the defense market for new technology as ". . . a market in which scientific achievement may be the major requirement. The intensity of the customers demand may be far less a function of his available income than of the products or systems available through technological advance." [Ref. 23]

A major problem associated with utilization of new technology has been underestimating the costs of risk and uncertainty. Costs and uncertainty are greatest when proposed weapon systems push the frontiers of knowledge. Current defense efforts aimed at identifying and controlling technological risk center around prototyping and testing. It is possible that these efforts occur too late

in the acquisition process unless previous attempts have been made in Phase I to separate those mission deficiencies which should be corrected by application of new technology from application of new technology to achieve those capabilities that might simply be nice to have.

4. Replacement of Obsolete Equipment

Obsolescence of existing equipment is another source of needs. Most major acquisition programs are initiated in order to provide replacements for existing weapons. Specific requirements for replacements are often assumed without the benefit of the type of thorough analysis that a new system might be subjected to.

A case in point is the continuing attempts by the Air Force to obtain authorization for a strategic bomber to replace the aging B-52 fleet. (The following account is not an argument for or against a replacement for the B-52 but merely illustrates the lack of rigorous requirements determination processes that can occur when replacement systems are requested.)

Five million dollars was included in the fiscal year 1965 budget for the Air Force to proceed with the program definition[1] phase of a replacement bomber for the B-52.

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[1]The development of a major weapons system ordinarily follows the following steps: (1) studies to define the need and concept of employment sufficiently to establish the desirability of proceeding and to define performance characteristics and requirements in sufficient detail to permit (2) program definition in which industry makes proposals for hardware to meet those requirements leading to (3) development of actual hardware and, if this development is satisfactory, (4) procurement of operational quantities.

The Air Force, however, had no authority from the Secretary of Defense to conduct such program definition. During the preceeding two years the Air Force conducted program studies to determine just what kind of aircraft they would like and what its role in the strategic system would be. These studies concluded that an advanced manned strategic aircraft was urgently required to complement missile capabilities during the 1970 time period. They explored three different means of employing manned systems in the strategic field: one was a high-altitude bomber capable of a role similar to that for which the B-70 was designed; another was a long-endurance missile carrier that could remain aloft for several days; the third was a low altitude penetration bomber. These studies, the concept of operations, and other proposals required by the Secretary of Defense prior to making a decision, had not been forwarded to Secretary McNamara at the time of the authorization and appropriations hearings. The reason given by General LeMay was, "because (Secretary McNamara) has asked additional questions of how we intend to use these bombers, what the operational concept is going to be, and how many of them are going to be needed. These are very difficult questions to answer at this particular time." [Ref. 13] Since Secretary McNamara had not reviewed these formal proposals for a follow-on bomber he did not request funds for program definition in the fiscal year 1965 budget. General LeMay, however, felt that the problem was of such urgency

that he requested $52 million to conduct program definition during testimony before the House Committee on Armed Services. The Armed Services Committee approved the request. Secretary McNamara later urged the House Appropriations Committee not to approve the request.

The following comment was made by Dr. Harold Brown, then Director of Department of Defense Research and Engineering. "The project definition would involve a detailed engineering design. I do not see how you can have a detailed engineering design without a concept of operation to answer questions such as: Where is this airplane going to go? How many are there going to be? Where is it going to be based? You must have that before you to do a project definition. Maybe the Air Force will have it but I do not think even they would say they have it now." [Ref. 13] Obvious deficiencies existed in Air Force follow-on bomber program planning. In the above example the "product oriented" statement of need was rejected at the Secretary of Defense level (although Congress did provide the $52 million for the program). A better solution to this and similar problems lies in improving the planning and review process at the Service Chief or Service Secretary level in order to filter out obvious service bias. This particular bias frequently assumes that there is a "requirement" to replace existing major systems with succeeding generations of similar systems on a one for one basis. Seldom are alternative systems proposed by the services. Seldom is

increased performance achieved in succeeding generations of weapons systems used by the Services to justify a reduction in the number of aircraft, ships or missiles.

C. INFLUENCING FACTORS FOR NEED DETERMINATIONS

1. Interservice Rivalry

A persistent problem in the broad area of requirements determination is Service competition for roles and missions and for the budget dollars to support these missions. A commonly held belief is that prior to World War II competition for roles and missions was non-existant. The rationale for this belief is that each Service's control of specific weapon systems was determined by the medium through which it moved--land, sea or air. The assertion is that modern technology and the nuclear age upset this "natural" mission separation. The following example, which occurred in the 1930's, illustrates that neither the problem of overlapping roles and missions nor the all too common "solution" is just a post-war phenomenon.

> The dispute of the Army and Navy over air power was by no means academic. It was often expressed in seemingly trivial terms--for example, minor overlaps in functions such as the operation of patrol planes--but behind the facade of details lay a fundamental struggle for power. Navy spokesmen held that "sea operations" were "inherently" a function of the Navy . . . whether . . . carried out by surface ships, subsurface ships, or aircraft. Army representatives with little confidence in the future of strategic bombers might be willing to concede this much, but how could they accept the Navy contention that "money spent on our Army could, with more profit toward guarding our continental coastline, be spent in augmenting naval strength . . ."? With

> so much in the way of pay, promotion, the hope of command, and the whole question of career tied up in the matter, it was difficult for either Army or Navy officers to take an utterly detached view.
>
> Unable to reach any fundamental agreement on doctrine, Army and Navy officials resorted to an old formula: they would agree to disagree. All controversial discussions of Army-Navy operations, warned a General Staff officer, should be studiously avoided. This was the essence of the "solution": solve the problem by virtually ignoring it. High-ranking officers contrived an accord only by defining the respective missions of the services in very general terms that avoided exploring the areas of overlap too closely, and once this "agreement" was drawn, they fended off every effort to reopen the question. [Ref. 11]

It is not unusual that each Service should see in an existing or developing enemy threat predominantly those elements which its own particular organization seems best adapted to counter. Each service by a natural rationalization judges the proper balance of forces to be the one which maximizes its own role. Differing views of mission responsibility may or may not be properly labeled "parochialism" on the part of the Services. More important than labeling Service reactions is eliminating unplanned, uncontrolled, unaffordable duplication of weapon systems and wastage of scarce resources. Answers to the problems of interservice rivalry become urgent as the defense budget declines. There is no justification for the services to give responsible observers the basis to claim that, "more time and energy has been expended at the policy-making levels of the three armed services on who is going to do what with how much money than on appraising the external threat." [Ref. 21]

Tactical air warfare is a current example of an area where service missions overlap. The recent controversy involving the Army Cheyenne helicopter, the Air Force AX (now A-10) aircraft and Marine British built AV-8A Harrier aircraft illustrates contemporary service competition for roles and missions. The controversy has not been resolved although the Cheyenne program was terminated in 1973. The Army is now requesting funds for an advanced attack helicopter (AAH).

Proposed solutions to the problems of interservice rivalry range from creation of a single service to revision of the Key West agreement.[1] An alternative approach utilizing the existing DoD organization is presented in the Conclusions and Recommendations section.

2. Defense Industry Marketing

Some systems come into being as a result of the initiative of government contractors. A contractor may develop a new weapon system approach and propose it to an agency in DoD. In this case a new or innovative concept introduced by a contractor may induce a product oriented statement of need. If the "need" generates a firm requirement it will be for a specified system. While in retrospect the resulting system may function properly, the question should be asked whether the system fulfilled a need or if the need was created to justify the desirability of having

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[1]The Key West Agreement of 1948 was an attempt to assign service roles and missions in order to limit interservice rivalry.

the system. A former president of the Air Force Association claimed:

> The day is past when the military requirement for a major weapons system is set up by the military and passed on to industry to build the hardware. Today it is more likely that the military requirement is the result of joint participation of military and industrial personnel, and it is not unusual for the industry's contribution to be a key factor. Indeed, there are highly placed military men who sincerely feel that industry currently is setting the pace in the research and development of new weapons systems. [Ref. 19]

To what extent does the government depend on the contractors' engineers for the perception and resolution of "system answers," whether formulated by the government or a potential supplier? There is a legitimate dependency on the private sector to propose solutions to solve military needs; but it is imperative that the Services have the "in-house capacity" to analyze the potential contribution industry sponsored weapon systems can make in satisfying valid mission deficiencies.

D. PROBLEM SUMMARY

There have been several persistent problems associated with generation of formal statements of need. The problem of product oriented statements of need currently is being addressed by revising Service program planning and initiation policies. The proposed policies appear to emphasize stating needs in terms of capabilities and concepts rather than systems and hardware.

A second major problem, that of inadequate national security policy and fiscal guidance to the Services, is

being addressed by use of the Policy and Planning Guidance document. Several other serious problems remain in Phase I however. These problems are biases that are associated with need perceptions. The problems are summarized below. Their cumulative effect is to cause the services to ask for more capability than is actually necessary to eliminate mission deficiencies.

a. An upward bias resulting from intelligence that may overestimate enemy capabilities.

b. An upward bias resulting from use of "greater than expected" threat analysis.

c. An upward bias resulting from indiscriminate reaction to advanced technology.

d. An upward bias resulting from service desires for a one for one replacement of existing systems.

How these problems may interact and influence each other is illustrated in Figure 3.

III. SELECTION OF REQUIREMENTS

A. DISCUSSION

The second phase of the requirements determination process is the response of military and industrial research and development effort generated by the statement of needed capability. The response draws upon a technology base to support exploration of areas leading to possible conceptual ideas to fulfill mission deficiencies. (See Fig. 4)

PROBLEM MATRIX

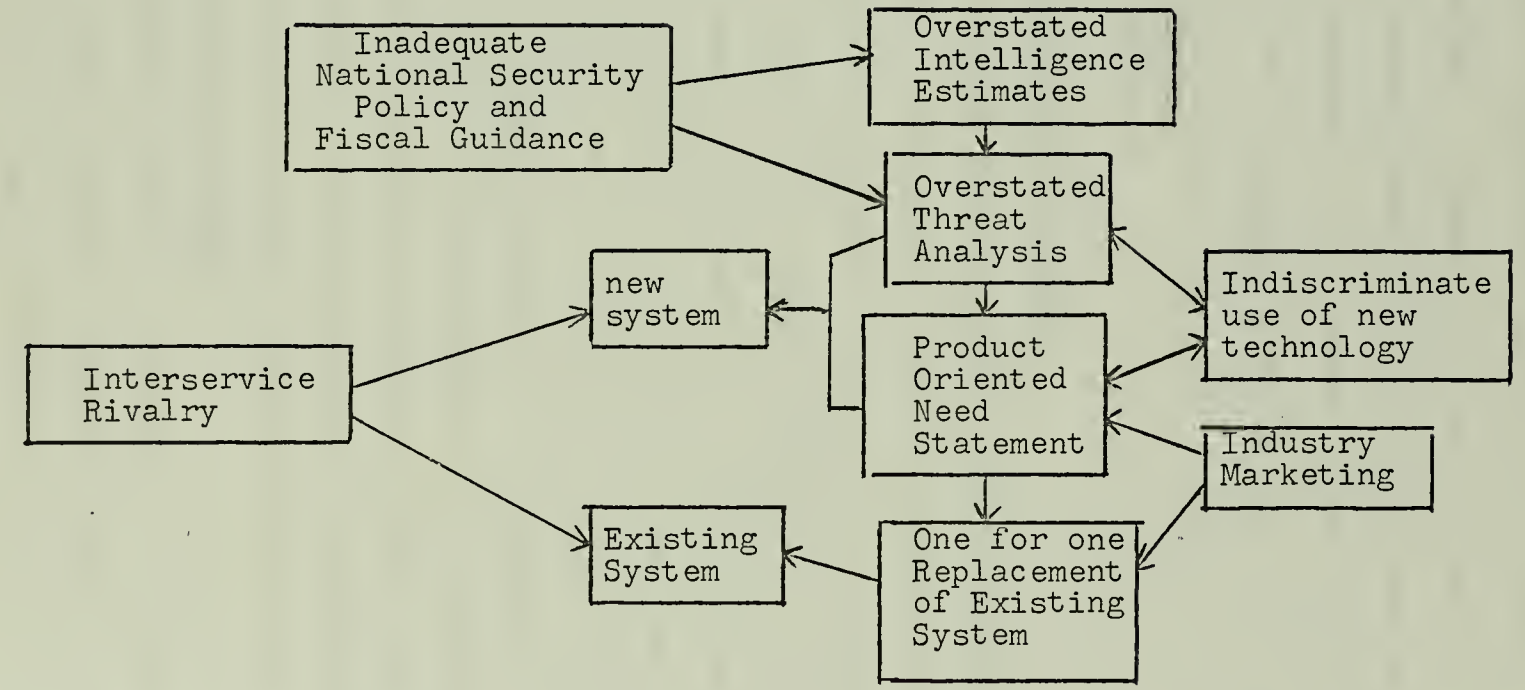

FIGURE 3

These conceptual ideas may include different system designs to meet similar missions. The alternatives may be limited to different engineering approaches to produce a single system concept. However if alternatives are not considered the requirements determination process may be constrained unduly. Frequently this locks us into single system approaches which produce great cost growth, schedule slippages and performance shortfall problems in system production contracts.

B. RESEARCH AND DEVELOPMENT

The Research and Development (R&D) program has two objectives. A long range goal is to advance technology in scientific fields that have some application to defense. The second goal is to provide answers to specific development problems. The Director of Defense Research and Engineering (DDR&E) is the principal advisor to the Secretary of Defense on scientific and technical matters. DDR&E has been directed to supervise the management of R&D in DoD.

To facilitate the management of the R&D program, DDR&E has divided it into six categories. The first three of these categories influence greatly the determination of how requirements could be fulfilled. (See Fig. 5)

1. Defense Research

Defense Research (Category 6.1) is scientific study and experimentation directed toward increasing knowledge in general areas of science that may have application

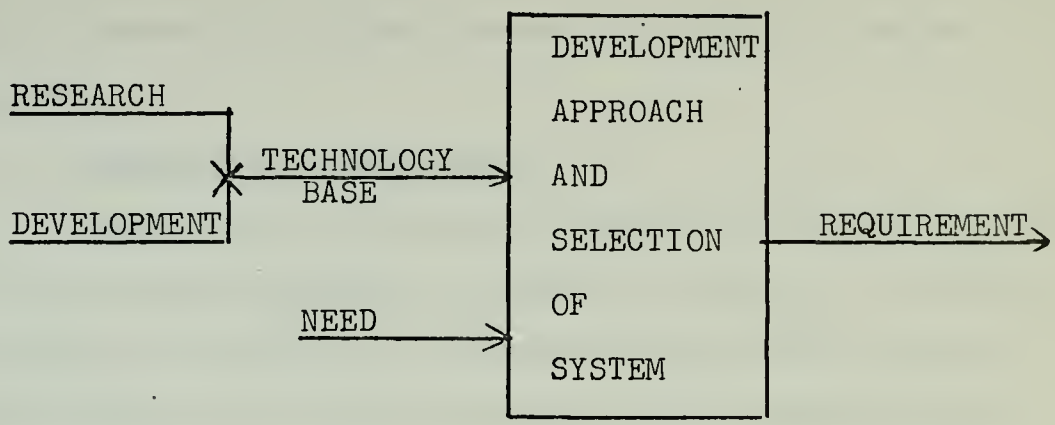

FIGURE 4

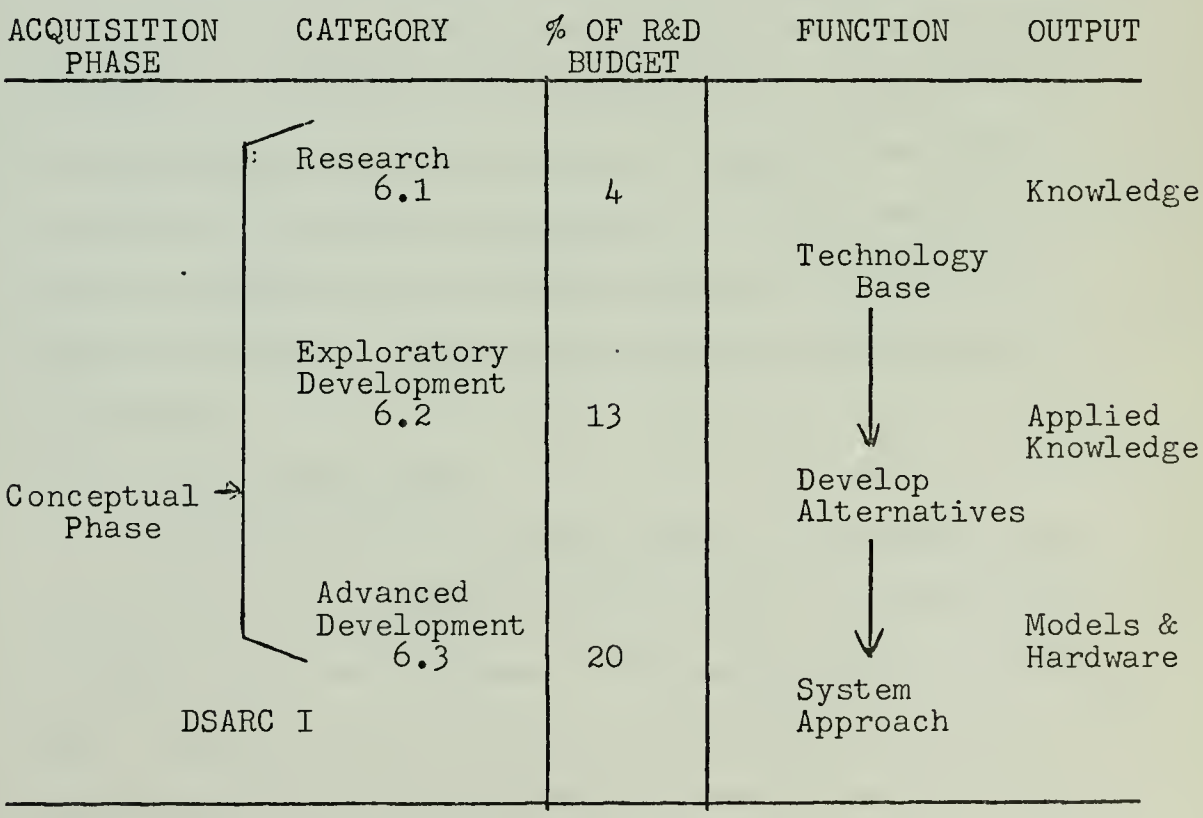

FIGURE 5

to defense programs. It should provide fundamental knowledge for the solution of identified military problems but should not be directed to support predetermined weapon system solutions.

2. Exploratory Development

Exploratory Development (Category 6.2) should build upon this basic knowledge and begin to apply it to hardware development in support of conceptual approaches to solve defense needs. This effort should begin to develop and evaluate the feasibility and practicability of proposed alternatives.

3. Advanced Development

Advanced Development (Category 6.3) is directed at proving a design concept and may include the building of models to test the system feasibility. DSARC I[1] for the initiation of a program usually takes place around the middle of advanced development. At that decision point the development should be advanced sufficiently to allow selection of a system approach from alternative approaches.

4. R & D Management

The problem of managing R&D is a formidable one. A structure of management controls has been established by DDR&E to aid in this task. The Technology Coordinating Paper (TCP) describes what can be done with existing technology, defines priorities for work on new technology

[1]Defense Systems Acquisition Review Council first decision (program initiation).

and presents plans for doing the essential work. The Area Coordinating Paper (ACP) is a mission-oriented paper that discusses what is being done in R&D in specific mission areas.

The JCS, in their role of advising the Secretary of Defense on R&D matters prepares a Joint Research and Development Objectives Directive (JRDOD). This document identifies specific deficiencies in the DoD R&D objectives and provides indicators of the relative military importance of ongoing R&D programs. Inputs to this document come from the Services and the Unified commands.

Each individual service provides for the actual conduct of R&D efforts to support the mission needs. To provide for effective management of this effort, an extensive planning and monitoring system has been established. The planning documents are designed to interface with the Joint Program for Planning. The monitoring documents include various documents that track what is being done in each category of R&D, showing what system development can be supported and what technological developments are expected in the future.

C. PROBLEM OF SPECIFYING A SINGLE-SYSTEM APPROACH PREMATURELY

The second phase of the requirements determination process should be responding to a statement of need. Whether this is a statement of mission deficiency or a specified design approach has a significant effect on how systems are generated. When the process is constrained

to a specified approach at this very early stage, the opportunity for innovation and introduction of alternative concepts is minimal.

✓ The technology base must be developed through efforts of government laboratories, universities and contractors conducting general research and exploratory development work. These activities are funded with a relatively small portion of the R&D budget. How this money is spent becomes very important if a good technology base is to support the demands of advanced development.

The managers of this early R&D effort generally have a motivation to supply what a user "demands." If the demand is for new systems which are little more than improved versions of old systems, this motivation will cause early R&D efforts to be directed toward developing improved subsystems and components. A constrained budget may not allow both subsystems development and technology base development. Since many new systems today are developed from the beginning as a better version of an existing system, the early research effort may suffer in favor of subsystem development or stretching old technology to meet new perceptions. This problem is compounded by a shrinking budget in the 6.1 and 6.2 categories.

Even with an adequate technology base, alternative approaches will not be developed when the process is constrained by a specified design approach in the statement of need. Many new systems are replacements for similar

systems. This is not in itself evidence that alternatives should not be considered. For many missions there may be only one type of system that will be acceptable. However, an early decision on the exact design approach will rule out possible engineering innovation to introduce more efficient ways to build the system. The easiest and often the only possibility examined is to make all the components of an old system "a little better." New technology may even present an entirely new approach to perform a mission, but such new methods will never be examined if the design approach is dictated in the statement of need.

Time, money or political factors often cause the process to "choose" the pre-determined system. If the need for a new capability is critical or if there is not enough money to spend on pursuing alternatives, the easy answer seems to be to begin development with the specified approach. Decisions like this are made looking only at the needs imposed in a short time frame. A premature choice of a system approach may involve technical risk that may lead to both cost and schedule growth in the long run. This type of difficulty in the later acquisition process might be averted by spending more money in early development to reduce the degree of technical uncertainty and increase the range of alternatives from which to choose.

Even when several approaches are outlined, the choice of the preferred design may be made on the basis of inadequate studies. DoD has moved away from parallel development

in most programs because they have deemed it too expensive. Contractors often are unwilling or unable to fund unsolicited development for the same financial reason. As a result of these economic considerations a contractor is selected early in "development" and the design is usually dictated in the contract. Frequently this contract is written before the specifications can be well defined. As a result problems arise during development and production but the Government finds itself in a "sole-source" situation. Since there is no other immediate source to fulfill the requirements, the Government must now issue change orders to correct any deficiencies in the premature design. These change orders are frequently the source of much cost growth and long schedule delays.

D. HOW ALTERNATIVES COULD BE DEVELOPED

As a result of the tendency to select a system too early, alternative system approaches often are not considered. The development of these alternatives should mean independent approaches to solve a problem. There are several ways to obtain independent approaches. This effort can be done in-house using laboratories or by assigning one laboratory as a technical director who would supervise soliciting proposals from industry.

Each Service maintains laboratories that specialize in certain areas of R&D. If the need statement is written in terms of a mission deficiency more than one of these

laboratories may have the expertise to apply their research efforts to sponsor a design concept.

If alternatives are not forthcoming from in-house laboratories, a procedure similar to the contract definition process might generate system approaches from industry. In this application the request for proposals would be stated in broad problem terms. Any promising replies to the proposal should then be funded for further development. This funding should continue until the approach proves inefficient or shows enough feasibility to warrant higher levels of effort. This second approach brings industry into the process early with flexibility to use their design ability to create new ideas.

If more than one approach survives this early development effort, a decision must be made as to whether to continue the parallel efforts or to pick one approach. This decision should be delayed until it can be made on a basis of relative technical certainty about the approaches.

E. CHOOSING AN ALTERNATIVE

There are two basic methods to choose among alternatives. The choice may be based on an analysis relating the design or conceptual approaches to the relative technical risk involved. It may also be based on the results of testing prototype hardware of competing approaches.

The emphasis in the 1960's was on Systems Analysis as a basis for the selection of systems to fulfill requirements.

The shortcoming of this type of study is that it includes many uncertainties which cannot be anticipated by initial formulation of the problem. The element of judgement is very great and is very dependent on the initial assumptions made. When these assumptions are made in isolation of operational elements they are very prone to error. Systems analysis is very valuable to help define the problem but paper studies do not adequately anticipate the technical and financial risk.

The second approach allows the development of two or more design concepts to continue until a hardware prototype can be constructed and tested. The results of this testing can then be used to make the decisions on further development. Such decisions could involve picking one design, none of them, or a decision to continue more development and testing before making a final decision.

The disadvantage to the prototype method is the cost involved. However, money spent at this early stage of development can do much to ensure choosing the correct system and being able to solve technical problems before costly engineering development begins.

F. CONCLUSION

The results of this phase, however conducted, produce a proposed requirement. The Service conducts the development of a system until such time as it is determined that a major defense system program should be pursued. The plan

for the program is outlined in a Development Concept Paper and submitted to the DSARC for consideration and the Secretary of Defense for a decision. Phase III discusses the aspects of this Secretary of Defense decision.

IV. SECRETARY OF DEFENSE APPROVAL

The National Security Act of 1947 and the subsequent Defense Reorganization Acts created and strengthened the Office of the Secretary of Defense to enable him to exercise direction, authority and control over the entire Department of Defense. The power given to the office is sufficient to allow the Secretary to control the separate Services so as to serve the accomplishment of a total defense mission.

There have been two basic management philosophies described by students of defense management. One style emphasizes strong central decision making while the second allows more decision making by the Service Chiefs. The type of management employed by the Secretary may have a large impact on how weapon systems are conceived and developed.

The McNamara years were characterized by strong control of the weapon acquisition process. In some cases, such as the F-111 airplane, the momentum for a new program came from the Secretary and not the Service. Service planning was sometimes changed without procedures for appeal. This type of control produced dissatisfaction

within the Services. As a result of this dissatisfaction, the Services reverted to open dissent with the Secretary of Defense. Critics contended that the morale of military leaders and Service Secretaries had fallen; that military judgement and professional expertise had been downgraded; that arbitrary centralization and standardization made for mediocrity and the loss of creative values that should stem from initiative, variety and debate. [Ref. 14]

Prior to the McNamara years the Services had often been given more freedom to control the requirements decision making process. This was due, in part, to the strength given the individual Services before the reorganization acts of 1955 and 1958. This lack of significant control resulted in service rivalry, unnecessary duplication in development, and general disagreement on how best to satisfy the total needs of national defense.

The present method of defense management seems to be a compromise between the two extremes described above. The "milestone decision-making process" used in major weapon system acquisition is an example of this management philosophy. The DSARC system allows the Services to conduct the acquisition process in an independent manner while OSD imposes control at three specific decision points. The Services must have each major program reviewed and approved prior to the initiation of a major phase in the acquisition process; program initiation, full-scale development and production. These reviews are conducted

by the Defense System Acquisition Review Council (DSARC) and the decisions are made by the Secretary of Defense.

This process is an excellent example of decentralizing responsibility and authority while maintaining visibility and control of the Service efforts. The major deficiency of the process is that it does not monitor the requirements determination process. The first DSARC decision does not occur until after the Service in effect has chosen a system approach to fulfill a stated need.

Since conceptual effort is conducted within each Service, actual requirements determination process may not receive effective review and reconciliation at the OSD level. The Services define needs and conduct the early development that leads to the selection of a system approach. This selection is made independent of OSD review. There is therefore little motivation in the Services to furnish information to OSD about alternate design concepts that were rejected. This lack of information increases the chance that the Secretary of Defense may approve the Services initiation of a systems choice.

Since the Secretary of Defense is responsible for the Defense budget request, he must insure that all program decisions are made in concert. When a program receives his approval it is added to the procurement budget request. This program is reviewed by the Authorization and Appropriation committees of both Houses of Congress. When members of Congress question him on the validity of programs, the

Secretary's defense of it depends on the information he has received. Under today's procedures he would seem to have very little information regarding viable alternatives for a recommended program.

How Congress reacts to budget requests also depends on the information available to it. The next section discusses the Congressional review of the defense budget.

V. CONGRESSIONAL APPROVAL

It is the task of Congress under the Constitution to raise the armed forces. In the requirements determination process, however, the role of Congress has been an after the fact, fiscal approval or disapproval of weapon systems proposed by DoD. In order to exert some measure of control over major weapon systems and the defense policies which they are intended to implement, DoD programs are subject to two types of approval in both the House and Senate. Congress passes substantive legislation both authorizing specific programs and providing appropriations in their support.

The House and Senate Armed Services Committees conduct hearings on research and development, ships, aircraft, missiles and other major weapon systems. Witnesses before these hearings may include the Secretary of Defense, Chairman of the JCS, Service Secretaries and Service Chiefs. These witnesses deliver general posture statements and answer questions posed by the Committee members. Both

committees report out a bill to their respective assemblies. Differences, if any, go to conference for a final compromise bill which is again voted by each house of Congress.

The Appropriations hearings of the Defense Subcommittees of the House and Senate Appropriations Committees begin in the House. The final House report is sent to the Senate Committee. The final bills go to a joint conference and a compromise bill is finally delivered out of Congress.

Analysis of Congressional action indicates which areas appear most important to the members. The greatest percentage changes to the defense budget have been in Procurement and Research Development Test and Evaluation (RDT&E). This indicates that Congress is interested in new defense programs. Other areas that draw Congressional interest are perceived changes in the international environment such as the "missile gap" or "bomber gap." How proposed systems may influence U.S. military commitments or policy such as the Fast Deployment Logistics Ship (FDL) also draw Congressional interest. Congress also watches carefully the multibillion dollar systems that absorb the greatest expenditure of resources.

The major issue with the existing role of Congress in the requirements process is that Congress has poor visibility of defense mission deficiencies and the early defense decisions on programs designed to eliminate those deficiencies. This may result in a general lack of confidence on the part of Congress in supporting defense objectives.

Congress has no way to assure itself that fiscal support to proposed major weapons systems will indeed contribute to satisfying defense needs. The present lengthy authorization and appropriations hearings reflect a desire on the part of Congress to gain confidence in supporting defense needs. A better way to achieve Congressional confidence is for DoD to give Congress early visibility of perceived defense mission deficiencies, to assure Congress that real alternatives are being created to address those deficiencies and that final requirements determinations follow the accumulation of hard data regarding these alternatives.

Congressional review and approval of R&D budgets should be premised on the creation of alternatives to meet mission needs and explicit Congressional understanding of the mission deficiencies these needs are to serve.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. BACKGROUND

The Thesis is intended as a conceptual problem statement regarding the function of requirement determination rather than as an across the board attempt to reconcile all current programs to a single decision making standard. While individual programs are used to illustrate aspects of the requirement determination function it is not the intention of this thesis to address characteristics of programs which follow naturally from a basic decision

making process, but to examine the process itself. With the initial focus on the requirements determination process, problems and recommendations for solutions can be approached systematically.

B. SUMMARY OF PROBLEMS

Formal statements of need originate at the Service level based on national policy objectives, threat assessments and/or perceived mission deficiencies. These statements too often describe a design concept for a specific system rather than a description of a mission deficiency which warrants the examination of alternative solutions. Moreover, these statements often are not satisfactorily coordinated among the Services and there is little evidence that they are subsequently prioritized by OSD or OMB to reflect Defense needs on an overall basis and the relationship to other Government program objectives.

The process of establishing needs is often biased to demand more capability than is really needed. The intelligence community tends to predict an optimum threat. Contractors predict the ability to produce a greatly increased capability in order to win contracts. The Services may demand systems that meet an exaggerated threat using the optimistic supplier estimates of greatly enhanced capability. The net result is that we may be demanding many systems with a greater capability objective than is required.

There is no effective mechanism to appraise Congress of the rationale behind an aggregate of mission needs and their relative priority. The request for appropriations of R&D money is not premised on an analysis of mission areas or the interrelationship of problems to be solved, but rather on individual program items that are thought to be important in themselves.

Because a statement of need usually anticipates a design approach, there is little opportunity for the development of alternatives to the specified approach. This practice stifles the selection in the requirements phase of the acquisition process and leaves very little room for innovation and change.

The result of a premature selection of a system has several ultimate effects. Efforts to develop a strong technology base independent of supporting specific systems are discouraged. The motivation in research and exploratory development may be to take a very narrow course toward improving components and subsystems of existing hardware.

The premature selection of a system concept usually leads to decisions to initiate a contract and start advanced development as early as possible. This decision may be made in spite of major technical uncertainties. As a result system development is frequently plagued with major design revisions leading to change orders, increased cost and schedule delays.

The Secretary of Defense must confirm a Service decision to initiate a program and have it included in the Five Year Defense Plan. The Secretary of Defense decision is made at DSARC I. The decision is based on the assumed technical feasibility of the proposed system without necessarily considering whether the Service made a selection from a range of real alternatives. The DSARC I decision may be made without regard to current or proposed efforts by other Services related to the same mission area.

By the time Congress is asked for prototype and/or production money for a specific system, the design approach is firm and alternative courses of action are really no longer considered. The choice given to Congress is to accept the one "best" answer perceived by the Service or potentially leave the mission deficiency unanswered.

C. RECOMMENDATIONS

1. Background

The authors feel that the overriding problem in the requirements determination process is the great tendency towards "product-oriented" statements of need. The premature designation of a system approach seriously constrains the entire acquisition process. The solution is to require stronger management direction of the existing process within the Services and between the Services and OSD.

The Services all produce statements of need. There is some effort at coordination among the Services. The existing JRDOD and the Mission Concept Papers both should

examine the efforts in R&D by mission area. However this recent effort at coordination has not yet shown that it will ensure that statements of needs will define mission deficiencies and elicit alternative system approaches.

2. Recommendation I

OSD should conduct an annual review of the statements of need produced by the Services.

The preparation of a statement of need and the priorities in each mission category should be done by the Services with coordination among the Services by the JCS. The Service review should support the Program Objective Memorandum and the JCS coordination should be reflected in the Joint Forces Memorandum. Annual statements of these mission needs could then be submitted to review by OSD. A panel similar to the DSARC but meeting in advance of the current DSARC I would be the proper level for this review. This review should ensure that the statements of need are stipulations of mission deficiencies that are defined against a reasonable threat prediction. The requested mission capability should be in agreement with current national policy as interpreted by the Secretary of Defense in the Policy and Planning Guidance Memorandum. The report of this review group should be forwarded to the Secretary of Defense for approval. The report could also serve as the basis to review the entire research and exploratory development program. The R&D budget should represent, in part, a summary of the review of statements

of need for use by the Authorization and Appropriation Committees to make decisions regarding the purpose and validity of R&D appropriations.

3. Recommendation II

Each Service prepare a document similar to a DCP, defining the approach that will be used to explore design alternatives for each stated need and the method that will be used to select the system approach.

One of the major problems in the requirements determination process is that a system design may be prematurely selected and alternative approaches may not be considered. Early emphasis on dealing with capability deficiencies rather than defining specific answers will encourage alternative approaches to the mission capability. This emphasis on alternatives could be encouraged through the use of a Service-produced document similar to the Development Concept Paper (DCP). The focus of this DCP should be the standards to be used in promoting alternative design concepts and the criteria for selecting among alternatives. In those areas where Service DCP's indicate there is commonality of effort which may result in inter-service rivalry, DDR&E should coordinate the decision effort through the establishment of a joint development program or by assigning responsibility for that capability to a single Service.

A DCP of this type should be written in response to a statement of need. It should outline the procedure to

be followed to develop independent design approaches (e g in-house development, competing contractors, etc.), and whether prototypes or paper studies will be used to pick the final Service selection of a system to meet the need.

The DCP's produced by all the Services in a given mission area should be reviewed by OSD. Particular attention should be given to these DCP's at the annual review of statements of needs. Consideration must be given to the balance between the effort outlined in these DCP's, the prioritization of needs and the existing programs in the advanced stages of development. This type of examination should support the R&D budget request.

4. Recommendation III

DSARC I should reemphasize the following criteria:

1. What effort has been made to develop alternatives to the design concept chosen.
2. What is the criteria for picking a concept.
3. What other efforts are in progress in this mission area and what is this system's relationship to these.
4. Does this system fulfill a valid mission deficiency.

The decision at DSARC I emphasizes the technical aspects of the proposed system to determine whether sufficient progress has been made in development to

justify the additional funds for advanced development. This decision is important, however it should not be the only criteria for approving the selection of a system approach to meet a mission need. To ensure that this decision is not premature an examination of the available alternatives that have been developed should also be made. If the effort to explore independent alternative approaches has not been pursued sufficiently, the proper decision should be to delay the transition to a major program until other design concepts may be examined. The results of the analysis performed to pick the final approach should also be part of the review at DSARC I. The examination of alternatives should include a review of other Service's efforts in the same mission area. The DCP would be a good vehicle to make this review.

An examination of a proposed system choice should include a comparison of the mission capabilities specified to the stated mission need. The assumptions that precipitated the need should also be examined to insure that the statement of need is still valid. While the requirement to fulfill the minimum capability is important, the DSARC should also guard against the approval of a system concept that provides for more capability than is required.

A summary of this DSARC I review, subject to approval by the Secretary of Defense, could be used as a justification for the inclusion of a new program in the procurement budget. Such a report could include in one document

the need for the system, the alternatives considered, the justification for picking a single-system approach, and what effort is being carried on by other Services in the same mission area.

5. Conclusion

These recommendations are designed to correct deficiencies in the requirements determination process by introducing three specific improvements:

a. Outlines the method to provide adequate OSD review of the statements of need to ensure mission-oriented needs that reflect a reasonable statement of required capability in light of current policy, possible threat, and prudent fiscal demands;

b. Emphasizes a thorough exploration of definable alternatives and adequate measures to select the most efficient system approach from these alternatives; and

c. Provides OSD and Congressional visibility in the early stages of the requirements determination process; thereby motivating the Services to improve their procedures and to provide a better foundation for these agencies to approve or deny the Services' requests for new programs.

These recommendations could accomplish these improvements without the need for new agencies or new procedures. The basic change suggested here is to put emphasis on solving problems in the early stages when the Government has some flexibility.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The major weapon system requirements determination process should lead to optimum solutions to meet perceived defense mission deficiencies. This thesis raises the question of whether the existing requirements process is adequate to support optimum solutions to meet defense mission needs.

Principal areas of concern which affect the soundness of the requirements determination function are addressed. These include:

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(continuation of abstract)

a. Adequacy of information used for threat analysis.

b. The process of selecting specific requirements.

c. The timeliness and adequacy of information provided to the Secretary of Defense and Congress.

The thesis is intended as a conceptual problem statement regarding the function of requirements determination rather than as an across the board attempt to reconcile current individual programs to a single decision making standard.